TRICHOPTERA OF THE CAHABA RIVER SYSTEM IN ALABAMA[1]

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ABSTRACT: Distribution records for 146 species of caddisflies collected in the Cahaba River basin are presented and seasonal occurrence and abundance of each are indicated. Annotations include habitat notes and geographical distributions. Seven undescribed species are reported for the river system and two northerly species are newly reported from southeastern United States. Distinct faunas were differentiated on the basis of stream size and physiographic province.

The Cahaba River is one of the largest free-flowing rivers in Alabama. Although there is some municipal and industrial drainage into the river, large stretches remain relatively undisturbed. The biota of the river is considered to be particularly rich and unique, with 32 plants, 23 mollusks, and 9 fishes considered threatened or endangered within Alabama occurring in the river system (Boschung, 1976; Freeman et al., 1979). Studies of the aquatic insect fauna of the river have been few and primarily limited to environmental impact studies in the Birmingham area. This study lists the caddisfly species known to occur in the Cahaba River system and annotates their distribution. Distribution patterns are discussed in more detail in Harris et al. (in press) with which this paper should be considered a companion.

Description of River System

The Cahaba River originates north of Trussville, Alabama (fig. 1) in the Valley and Ridge physiographic province and flows southerly for nearly 245 km before joining the Alabama River near Selma on the East Gulf Coastal Plain. Within the Valley and Ridge, the river flows in the Cahaba Valley flanked by the Cahaba and Coosa Ridges. Soils are typically nonresistant sandstone and shale with some unconsolidated deposits of sand, clay and gravel. North of Centreville, which is situated on the fall line, the river flows through an area rich in limestone and dolomite. This is the most scenic and unique portion of the river, with the limestone outcroppings

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forming extensive shoals. The majority of species considered rare in the river system occur in this small section. South of Centreville the river flows across the Coastal Plain. The soils of this physiographic province are primarily fine to coarse sands and sandy clay with some deposits of gravel. In total, the river drains an area of approximately 4,700 km^2.

Water quality in the river is generally good (Table 1), although some degradation seems to have occurred in those river sections and tributaries in the Birmingham area. Dissolved oxygen levels are lower and nitrate and phosphate levels higher in the river sections near Birmingham, particularly in Shades Creek, a river tributary receiving domestic sewage.

Collecting Sites and Methodology

Adult Trichoptera were collected using UV light traps (BioQuip Universal Trap) at 24 localites in the Cahaba River basin (Fig. 1). Collections were concentrated within five sections of the river: river headwaters above Birmingham (sites 1-4, 6, 7); main river channel between Birmingham and Centreville (sites 8, 11, 12, 17, 18); river tributaries between Birmingham and Centreville (sites 5a, 5b, 10, 13-16, 19); main channel and tributaries in the Coastal Plain physiographic province (sites 20-24); and springs (sites 5c, 5d, 9, 15). Sampling was most intensive in the section of river north of Centreville which is considered the most unique portion faunistically (Chermock, 1977). Collections at sixteen sites were made at approximately monthly intervals, while collections at the remaining eight sites were made irregularly. Light traps were situated on the stream banks and operated for approximately one hour after dusk. Specimens were collected and preserved in 70% ethanol. In all, 81 collections were made in 1981 and 1982. Over 54,000 specimens, primarily males, were examined during the course of the study.

Annotated List of Species

Included with each species is information on distribution and abundance within the Cahaba River watershed. Collecting stations are shown in figure 1. Since collections were made at several dates within each month, seasonal occurrences were broadly defined. Distribution annotations are brief with a more detailed discussion contained in Harris et al. (in press). Number of specimens collected is indicated by ( ). In most cases only males of the species were identified and enumerated. Voucher specimens are deposited at the Geological Survey of Alabama and in the collections of the authors.

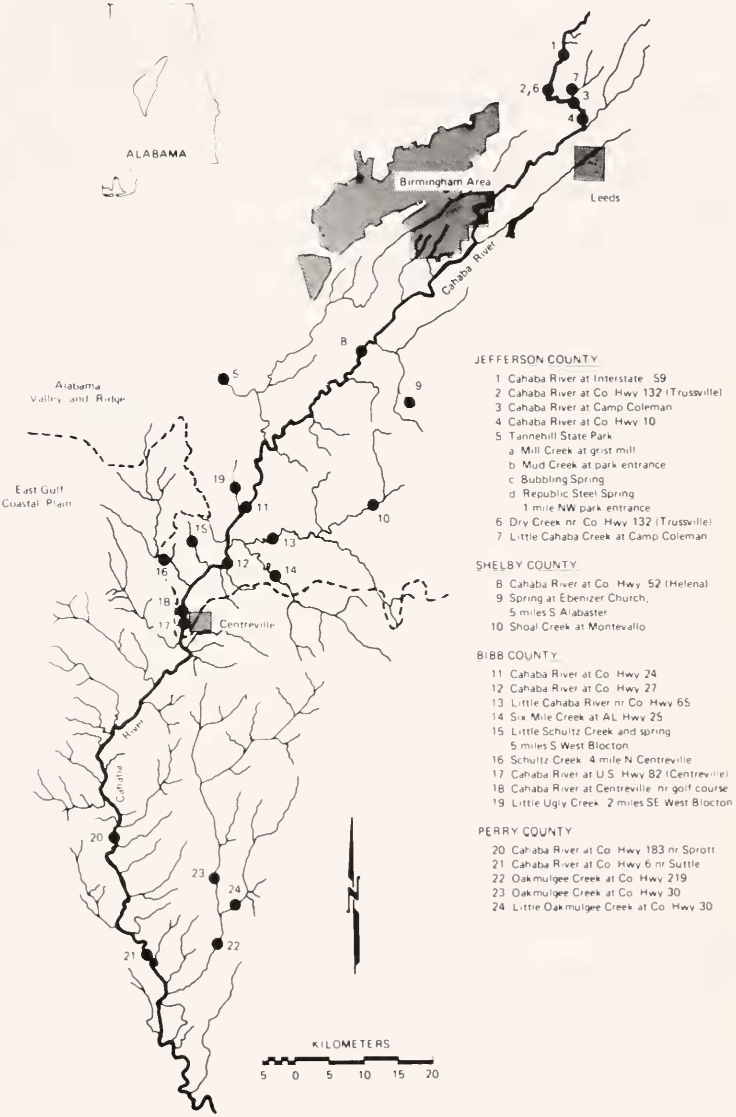
ALABAMA
Birmingham Area
Leeds
Cahaba River
Alabama Valley and Ridge
East Gulf Coastal Plain
Centreville
Cahaba River
1
2,6
7
3
4
5
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
KILOMETERS
5 0 5 10 15 20
JEFFERSON COUNTY
1 Cahaba River at Interstate 59
2 Cahaba River at Co Hwy 132 (Trussville)
3 Cahaba River at Camp Coleman
4 Cahaba River at Co Hwy 10
5 Tannehill State Park
a Mill Creek at grist mill
b Mud Creek at park entrance
c Bubbling Spring
d Republic Steel Spring
1 mile NW park entrance
6 Dry Creek nr Co Hwy 132 (Trussville)
7 Little Cahaba Creek at Camp Coleman
SHELBY COUNTY
8 Cahaba River at Co Hwy 52 (Helena)
9 Spring at Ebenizer Church,
5 miles S Alabaster
10 Shoal Creek at Montevallo
BIBB COUNTY
11 Cahaba River at Co Hwy 24
12 Cahaba River at Co Hwy 27
13 Little Cahaba River nr Co Hwy 65
14 Six Mile Creek at AL Hwy 25
15 Little Schultz Creek and spring
5 miles S West Blocton
16 Schultz Creek 4 mile N Centreville
17 Cahaba River at U S Hwy 82 (Centreville)
18 Cahaba River at Centreville nr golf course
19 Little Ugly Creek 2 miles SE West Blocton
PERRY COUNTY
20 Cahaba River at Co Hwy 183 nr Sprott
21 Cahaba River at Co Hwy 6 nr Suttle
22 Oakmulgee Creek at Co Hwy 219
23 Oakmulgee Creek at Co Hwy 30
24 Little Oakmulgee Creek at Co Hwy 30

Figure 1. Collecting stations in the Cahaba River basin.

Hydropsychoidea

Philopotamidae

Chimarra aterrima Hagen. Stations 5b, 5d, 6, 13, 16. March-October. (12)

C. moselyi (Denning). 2, 14, 16, 18, 22, 23. Widely collected and common in the basin, but most numerous in Coastal Plain tributaries. April-October. (78)

C. n. sp. 8, 12, 16, 18, 20-23. Collected in large tributaries and main river channel. June-August. (37)

C. obscura (Walker). 1-4, 5b, 5d, 8, 11-13, 15, 16. The most common *Chimarra* collected in the basin, widely distributed north of the fall line. April-October. (145)

Wormaldia moesta (Banks). 5c. May. (1)

Psychomyiidae

Lype diversa (Banks). 1-5c, 6, 8, Collected primarily in small tributaries and headwaters of the main river channel. April-October. (45)

Psychomyia flavida Hagen. 1, 2, 5a, 5b, 12-16, 18. Widespread and common in basin north of the fall line. (175)

Polycentropodidae

Cernotina calcea Ross. 4, 11-14, 18. Collected in large tributaries and main river channel. May-September. (71)

C. spicata Ross. 2, 11-13, 15, 20, 22, 23. Widely distributed in the basin. May-June, September. (56)

Cyrnellus fraternus (Banks). 3, 4, 5d, 8, 11-13, 16, 18, 20, 22. Widely distributed and common in the basin. May-October. (457)

Neureclipsis crepuscularis (Walker). 3, 11, 13, 16, 20. Collected in large tributaries and main river channel. April-October. (78)

N. melco Ross. 13, 23. June, September. (2)

Nyctiophylax affinis (Banks). 15, 16, 20. April, June, October. (6)

N. banksi Morse. 6. May. (1)

N. celta Denning. 1, 2, 12-14, 16, 18, 21-23. Widely distributed and abundant in the basin. May-October. (1527)

N. denningi Morse. 6. May. (2)

N. moestus Banks. 5a, 15. Only collected in two small tributaries during the spring and fall. (6)

Phylocentropus carolinus Carpenter. 14, 16. April, August (3)

P. placidus (Banks). 7, 8, 23, 24. Primarily collected in small tributaries. April, June, September. (13)

Polycentropus cinereus Hagen. 1, 2, 5c, 6, 13, 14, 16. Collected in small tributaries and river headwaters north of the fall line. April-June, September. (60)

P. confusus Hagen. 1-6, 14-16, 19. Primarily collected at the river headwaters and in small tributaries north of the fall line. April-October. (134)

P. crassicornis Walker. 5b. May. (1)

P. n. sp. (nr. *elarus*). 6. May. (2)

Hydropsychidae

Cheumatopsyche burksi Ross. 23. June. (1)

C. campyla Ross. 1, 3, 4, 5d, 7, 11, 12. Primarily collected in the main river channel north of the fall line. May-October. (616)

C. edista Gordon. 12. Primarily a Coastal Plain inhabitant. October. (1)

C. ela Denning. 3, 4, 5d, 8, 10-12, 14. Collected primarily in the main river channel north of the fall line. April-October. (43)

C. geora Denning. 16, 19. Rare in the basin but common in small central Alabama streams. August-October. (10)

C. gracilis (Banks). 1, 2, 5a, 13, 14. Collected in large tributaries, primarily station 13, and headwaters of the Cahaba. May-September. (66)

C. minuscula (Banks). 3, 5c, 8, 11-15, 18, 19. The most common Hydropsychidae collected, widespread in basin north of fall line. April-October. (2919)

C. n. sp. 1. July. (1)

C. nr. *wabasha.* 12. Probably represents a new species since *C. wabasha* Denning is only known from the Pacific northwest. October. (1)

C. oxa Ross. 1-3, 5a, 5b, 5d, 9, 15. Collected in springs and at the headwaters of the Cahaba. May-October. (89)

C. pasella Ross. 4, 8, 11-17. Widespread in basin north of the fall line. April-October. (721)

C. pettiti (Banks). 2-5a, 5d, 6-8, 12, 15, 16, 23. Widespread in basin although never collected in large numbers. April-October. (138)

C. sordida (Hagen). 14, 20-23. Primarily restricted to the Coastal Plain. April, June-September. (52)

Ceratopsyche cheilonis (Ross). 1-5a, 8, 10-16. Widespread in basin north of the fall line but most abundant at station 13. April-October. (345)

C. sparna (Ross). 1, 2, 5a, 5b, 14. Primarily occurring in small tributaries and headwaters of the Cahaba. May, October. (9)

Diplectrona modesta Banks. 21. September. (1)

Hydropsyche alvata Denning. 14, 20-23. Except for a single specimen taken at station 14, restricted to the Coastal Plain, primarily in the main river channel. May-June. (547)

H. betteni Ross. 11. May. (5)

H. depravata Hagen. 1, 3, 5a, 5b, 8, 10, 13-16. Widespread in river tributaries north of the fall line. April-October. (123)

H. dicantha Ross. 15, 19. April-May. (2)

H. elissoma Ross. 23. June. (2)

H. frisoni Ross. 1, 3, 4, 5a, 7, 8, 11-16, 19. Widespread in the basin north of the fall line but most abundant at station 13. (765)

H. hageni Banks. 3, 5d, 8, 11-14, 16, 18, 19. The most common *Hydropsyche* taken in the watershed; most abundant in the main river channel at station 12. April-October. (1089)

H. incommoda Hagen. 4, 14. May, August-September. (4)

H. mississippiensis Flint. 3, 14, 20, 22-24. Primarily collected in Coastal Plain tributaries to the river. April-July. (73)

H. orris Ross. 11-14, 17, 20-23. Primarily collected on the Coastal Plain. April-October. (296)

H. rossi Flint, Voshell and Parker. 1, 4, 5d, 8, 11, 12, 14, 16, 20-23. Widespread in the basin, but most common on the Coastal Plain. April-October. (179)

H. scalaris Hagen. 13, 14. May, September. (6)

H. venularis Banks. 3, 4, 8, 11, 14. Collected in large tributaries and main river channel north of the fall line. May-June, October. (9)

Macrostemum carolina (Banks). 8, 11-14, 17, 18, 20-23. Widespread in the basin, but most common on the Coastal Plain. June-August. (208)

M. transversum (Walker). 20, 21. Only collected on the Coastal Plain in the main river channel. June. (58)

M. zebratum (Hagen). 14. May. (3)

Potamyia flava (Hagen). 11, 12, 14, 20-23. Collected in large tributaries and main channel throughout the basin, but most numerous on the Coastal Plain. April-September. (515)

Rhyacophiloidea

Rhyacophilidae

Rhyacophila carolina Banks. 2, 5c, 6, 15. Collected in small tributaries and the headwaters of the Cahaba. May-September. (7)

R. ledra Ross. 1, 2. Restricted to the headwaters of the Cahaba. May, October. (8)

R. vuphipes. 13. Record tentative on the basis of larvae collected by D.A. Etnier. April.

Glossosomatidae

Agapetus hessi Leonard and Leonard. 14. May. (8)

A. rossi Denning. 14. This species and *A. hessi* only known in Alabama from this locality. May. (3)

A. tomus Ross. 1, 2, 13. May. (8)

Glossosoma nigrior Banks. 1, 2. Only collected at the headwaters of the Cahaba. May. (5)

Matrioptila jeanae (Ross). 14. May. (2)

Protoptila lega Ross. 2, 4, 5a, 8, 12-18. Widespread in basin north of the fall line, but most abundant at station 13. April-October. (1599)

Hydroptilidae

Dibusa angata Ross. 16. Many immatures collected at site in April from red algae (*Lemanea*). April. (16)

Hydroptila alabama Harris and Kelley. 2, 3, 14-16. Collected in small tributaries and at the headwaters of the Cahaba. May, August-October. (10)

H. amoena Ross. 14, 16. April-October. (24)

H. angusta Ross. 5d. July. (1)

H. armata Ross. 1-6, 8, 9, 11-16, 19. Widespread in basin north of the fall line, but most common in the main river channel at station 11. April-October. (4320)

H. callia Denning. 2. Only known Alabama locality for this species which had not been reported south of Kentucky previously. September. (2)

H. delineata Morton. 5d, 11-13, 15, 16, 18. Primarily collected in main river channel north of the fall line. April-October. (1490)

H. gunda Milne. 1-5a, 7, 8, 11-16, 18, 19, 21. Widespread in the basin primarily occurring above the fall line. April-October. (1889)

H. hamata Morton. 1-5a, 7, 8, 11-16. Widespread in basin north of the fall line, but most abundant at station 13. May-October. (903)

H. n. sp. (nr. *amoena*) 2, 5a-5c, 15, 19. Collected in small tributaries and at the headwaters of the Cahaba. April-October. (73)

H. n. sp. (nr. *eramosa*). 15. May, October. (2)

H. n. sp. (nr. *molsonae*). 22-24. Collected in Coastal Plain tributaries to the river. April, June. (225)

H. novicola Blickle and Morse. 15, 23, 24. Collected primarily in Coastal Plain tributaries. April-June, October. (13)

H. quinola Ross. 3, 4, 5b, 8, 11-16, 19, 21-23. Widespread in the basin. April-October. (260)

H. spatulata Morton. 3, 4, 5d, 11, 12, 15, 18. Widespread in basin north of the fall line, but most common in the main river channel. April-October. (33)

H. waskesia Ross. 1, 2. Only known Alabama locality for this species. May. (3)

H. waubesiana Betten. 2-5b, 7, 8, 11-16, 18-20, 22, 23. Most frequently collected caddisfly in the basin, widespread in watershed. April-October. (6608)

Mayatrichia ayama Mosely. 16. August. (13)

Neotrichia alabamensis Kelley and Harris. 22, 23. June, September. (3)

N. minutisimella (Chambers). 20, 23. As was *N. alabamensis*, only collected in the Coastal Plain. June, September. (4)

N. vibrans Ross. 4, 15, 16. July-October. (30)

Ochrotrichia graysoni Parker and Voshell. 1-3, 12, 13. Previously only known from Virginia, most abundant at station 13. May-October. (2466)

O. riesi Ross. 5b. October. (1)

O. tarsalis (Hagen). 2, 5d, 11, 12, 16-18, 20, 21. Widespread in basin. May-October. (309)

Orthotrichia aegerfasciella (Chambers). 1-5a, 5d, 7, 8, 12, 14-16, 18-23. May-October. (146)

O. cristata Morton. 1-4, 8, 13, 15, 16, 18, 22. As was *O. aegerfasciella,* widespread in the basin. June-October. (51)

Oxyethria coercens Morton. 12-14, 16, 19. Primarily a northeastern species; this record represents the southermost extension of its range. April-May, August-October. (45)

O. forcipata Mosely. 1. October. (1)

O. janella Denning. 11, 12, 22. September-October. (8)

O. lumipollex Kelley and Harris. 22. April. (2)

O. novasota Ross. 4, 5d, 13, 15, 16, 23. May-August. (14)

O. pallida (Banks). 1-4, 5d, 8, 11-15, 19-23. Widespread in the basin. April-September. (171)

O. zeronia Ross. 1-3, 5b, 5d, 14-16. Widespread, but uncommon, in basin north of the fall line. May-October. (20)

Stactobiella martynovi Blickle and Denning. 2, 4-5b, 11-14, 16, 19. Primarily collected in small tributaries north of the fall line. April-May. (208)

S. n. sp. 16. April. (4)

Limnephiloidea

Phryganeidae

Agrypnia vestita (Walker). 16. October. (1)

Ptilostomis ocellifera (Walker). 9. July. (1)

P. postica (Walker). 21. April. (1)

Brachycentridae

Brachycentrus numerosus (Say). 16. Record from a single larva identified by O.S. Flint. March.

Micrasema rusticum (Hagen). 16. April. (114)

M. wataga Ross. 1-3, 5a, 5c-6, 14-16. Widespread in tributaries to the river north of the fall line. August-October. (32)

Limnephilidae

Goera calcarata Banks. 15. May, September. (9)

Ironoquia punctatissima (Walker) 4, 13, 15, 20. September-October. (8)

Neophylax sp. 13. Record from larva collected by D.A. Etnier. April.

Pycnopsyche indiana (Ross). 1, 3, 4, 15, 16. Collected in small tributaries and headwaters of the river. October. (14)

P. luculenta (Betten). 16. October. (1)

P. scabripennis (Rambur). 5b, 15, 16. October. (5)

Lepidostomatidae

Lepidostoma latipenne (Banks). 15 May. (1)

Helicopsychidae

Helicopsyche borealis (Hagen). 1, 2, 4, 5a, 6, 13, 15, 16. Primarily collected in small tributaries and headwaters of the river. May-October. (224)

Leptoceridae

Ceraclea ancylus (Vorhies). 5a, 11, 13. Primarily collected in the main river channel at station 11. May-June. (224)

C. cancellata (Betten). 3-5a, 8, 11-14, 20-23. Widespread in the basin but most commonly collected in the main river channel. May-August. (892)

C. flava (Banks). 4, 8, 11-13, 20-23. Distribution similar to that of *C. cancellata*. May-June. (395)

C. maculata (Banks). 1, 3, 4, 5d, 8, 11-15, 18, 20-23. Widespread and abundant in the basin. May-October. (2713)

C. nepha (Ross). 1-5c, 13, 14. Primarily collected at the headwaters of the river. May. (128)

C. ophioderus (Ross). 8, 11, 13, 20-23. Primarily collected in the main river channel on the Coastal Plain. June, September. (775)

C. protonepha Morse and Ross. 1-5c, 8, 11, 13, 14, 19. Widespread in basin north of the fall line, but most commonly collected at the river headwaters. April-June. (325)

C. resurgens (Walker). 12, 14, 23. April. (7)

C. tarsipunctata (Vorhies). 1, 3, 4, 8, 11-16, 20-23. Widespread in the basin, but most numerous in the main river channel. April-June. (631)

C. transversa (Hagen). 5a-5d, 11-14. May-July. (78)

Mystacides sepulchralis (Walker). 1-3, 5b, 14-16. Collected in small tributaries and at the river headwaters. May-October. (28)

Nectopsyche candida (Hagen). Within the watershed, only collected in the Coastal Plain. June. (21)

N. exquisita (Walker). 8, 11-13, 20, 23. May-September. (78)

N. pavida (Hagen). 2-4, 8, 11, 12, 14, 16, 21, 23. As was *N. exquisita*, widespread in the basin. May-October. (42)

N. spiloma (Ross). 11, 12, 21. Only collected in the main river channel, easternmost range extension of this species. June-October. (25)

Oecetis avara (Banks). 3, 11-13, 16-18, 20-23. Widespread in the basin, but most abundant in the main channel and larger tributaries. May-September. (1814)

O. cinerascens (Hagen). 3, 11, 15, 20, 23. May-June, September. (28)

O. ditissa Ross. 1-4, 5b, 5d, 8, 12, 13, 15, 16, 18, 20-23. Widespread in the basin. May-October. (90)

O. inconspicua (Walker). 1-5d, 8, 10-16, 18, 20-23. More common than *O. ditissa*, but with a similar distribution within the basin. May-October. (736)

O. morsei Bueno-Soria. 13, 16, 22. June-October. (14)

O. nocturna Ross. 1-4, 8, 11-14, 16, 21-23. Widespread in the basin, with distribution similar to that of *O. ditissa* and *O. inconspicua*. May-October. (234)

O. osteni Milne. 1, 16. September-October. (2)

O. persimilis (Banks). 1-5a, 5d, 8, 11-14, 16, 18. Widespread in the basin, north of the fall line, but most numerous in large tributaries and main river channel. May-October. (429)

O. scala Milne. 11-13, 16, 18. Most commonly collected at station 16. June-October. (385)

O. sphyra Ross. 13, 16, 20-23. Primarily collected in river tributaries on the Coastal Plain. June-August. (224)

Setodes dixiensis Holzenthal. 11, 13, 15, 16, 22. Most common in large tributaries, particularly station 13, and main river channel. May-June, September-October. (482)

S. guttatus (Banks). 14. Previously only known from the northeastern United States. This species has also been collected in southern Alabama. August. (1)

Triaenodes ignitus (Walker). 1-4, 5b-6, 9, 18, 22. Widespread but uncommon in the basin. May-October. (21)

T. injusta (Hagen). 1, 2, 8, 11, 12, 14. Primarily collected in the main channel north of the fall line. May-June, September. (33)

T. perna Ross. 2, 5a, 12. May. (4)

T. smithi Ross. 23. June. (1)

T. tarda Milne. 22. June. (1)

SUMMARY

The Cahaba River yielded 146 species of caddisflies in 45 genera and 13 families. Hydroptilidae (35 species), Hydropsychidae (34 species), and Leptoceridae (32 species) were the dominant families. In comparison to the few caddisfly studies conducted on other large southeastern rivers (Resh et al., 1975; Gordon and Wallace, 1975), the Cahaba River seems to support a particularly rich fauna. The wide diversity of habitat in the river, including the rocky, swift waters of the headwaters, the shoal areas north of the fall line, and the slow, sandy waters of the Coastal Plain, probably accounts for the rich fauna.

The majority of species and individuals were collected during May and June (112 species, 36,647 specimens), but a diverse fauna was also present during September and October (90 species, 3,134 specimens). While most species were collected throughout the study period, including *Cheumatopsyche minuscula, Hydropsyche hageni,* and *Hydroptila armata,* others had more restricted emergence patterns. *Stactobiella* n.sp., *Dibusa angata,* and *Ceraclea resurgens,* for example, were collected only during early April, while others such as *Pycnopsyche* spp. and *Ironquia punctatissima* only occurred during early October.

Cluster analysis, using Jaccard's coefficient and based on species presence or absence at a station, indicated that the caddisfly fauna of the Cahaba basin also displayed geographical distribution patterns (Harris et al., in press). In general, three areas of the river system were recognized on the basis of a similar caddisfly fauna: a main river and large tributary fauna of the Valley and Ridge region (97 species); a headwater and small tributary fauna of the Valley and Ridge region (101 species); and a Coastal Plain fauna (58 species). Although many species were widely distributed within the basin, several were more restricted. *Hydropsyche betteni* was only collected in the main river channel above the fall line; eight species including *Macrostemum transversum* and *Nectopsyche candida* only occurred on the Coastal Plain; and 43 species, including *Agapetus* spp. and *Rhyacophla* spp., were collected only in tributaries and at the river headwaters.

These distribution patterns appear to be influenced primarily by physical parameters, including stream size, flow regimes, and substrate. Water quality within the watershed seemed to have a limited impact on species abundance and distribution. Of those parameters measured and compiled over a 35-year period, only dissolved oxygen levels were noticeably lower in some sections of the river (O'Neil, 1983). Water quality deterioration in the basin appears to be primarily limited to Birmingham and the surrounding area.

Table 1. Ranges of physiochemical water parameters in the Cahaba River basin (1976-1981)

	River sections				
Parameters	Upper Cahaba River	Upper Cahaba River (Shades Creek)	Middle Cahaba River (Birmingham area)	Middle Cahaba River (Centreville area)	Lower Cahaba River
Dissolved oxygen (mg/1)	4.8-13.0	1.4-12.0	1.1-13.0	2.9-15.0	7.1-14.1
Temperature (°C)	1.0-29.0	3.0-31.0	4.0-30.0	5.0-32.0	6.0-29.5
pH (units)	5.2-8.7	5.7-9.2	5.7-8.6	6.4-8.9	6.7-8.2
Hardness (mg/1)	14-180	20-230	17-120	24-140	26-97
Specific conductance (μmhos/cm)	55-680	139-657	104-315	24-380	76-228
Alkalinity (mg/1)	5-123	10-189	9-169	18-140	24-90
Sulfate (mg/1)	1.0-220	6.0-60	10-39	3.0-46	3.0-17
Nitrate (mg/1 N0$_3$-N)	0-9.8	.03-35	0-6.5	0-2.3	0-1.0
Phosphate (mg/1)	.02-3.0	.05-4.2	.01-2.1	1.0-2.1	---
Discharge (cfs)	---	11-7,220	0.39-1,440	90-83,600	224-83,400

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